ISS*Live!* Translator: From NASA Operations Nomenclature to Everyday Language

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Background: NASA Operations Nomenclature

ISS*Live!* is a software suite that allows the general public to view International Space Station (ISS) timelines (A. Khan, "ISS*Live!* Rich Internet Application Development for ISS Educational Outreach," Johnson Space Center Biennial Research and Technology Development Report 2011). A prime requirement for the display of ISS timelines is a translation of the short, highly abbreviated activity names used in the NASA operations environment, known as operations nomenclature, to something more public friendly. Ideally, the translated name is a phrase or short sentence that can be well understood by a middle school student without any unique knowledge. The ISS*Live!* Translator is a component of the software suite designed to perform the translations using a variety of techniques. It also performs two other essential functions in support of ISS*Live!*: protection of confidential, sensitive, or private data; and data conversion from ISS execution timelines to ISS*Live!* timelines.

Translation is possible because the timelines executed in support of the ISS use an activity naming scheme regulated by international agreements. The agreements specify the following: official names of hardware; verbs used for common actions, format, and word arrangement; and acceptable abbreviations. Activity names are further constrained to a maximum of 20 characters by the planning software used for timeline development. New activities are all assigned a unique name by their creator, adhering to the governing rules. Once created, the name is always the same whenever the activity is scheduled.

Translator Design

The ISS*Live!* translator uses a relational database to store translation rules. A rule is a one-to-one mapping of an operationally used character string to its translation. The rules are developed by users familiar with ISS operations and can be entered one at a time through an administrative interface or in bulk through a specially formatted file. Once the database is built, the translator application uses a series of logical branches, each of which applies one or more rules to build a complete translation of an activity. Depending on the activity in translation, the number of branches executed and rules applied vary. Once translation is complete, the new description is associated with the activity and a determination is made about the sensitivity of the data. Anything deemed sensitive will not be passed forward to the public front-end applications of ISS*Live!* Activity data that is operationally significant but of no use to the front-end application of ISS*Live!* is removed, and the whole output is reformatted to suit the needs of the ISS*Live!* front-end.

Process Description

The technique used to build a translation falls into one of three categories: direct translation; partial translation; or assembled translation. These techniques are mutually exclusive and are attempted in the order listed. The order is

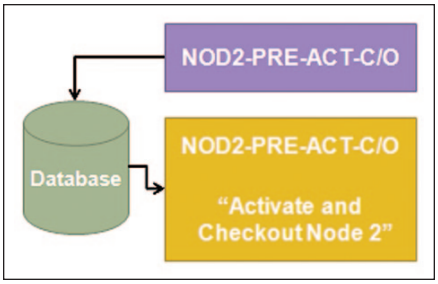

Fig. 1. Direct Translation: *The database contains a translation rule for the name NOD2-PRE-ACT-C/O. Since this rule uses the whole input, no other steps are needed to build a translation.*

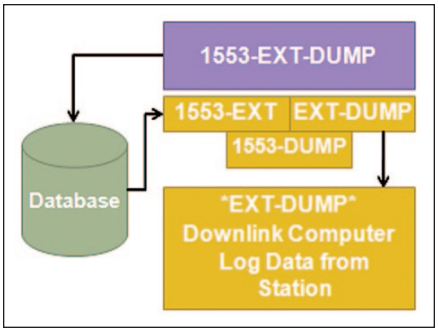

Fig. 2. Partial Translation: *The database does not contain a rule for 1553-EXT-DUMP; however, the partial name EXT-DUMP does have a rule, so the translation uses that rule.*

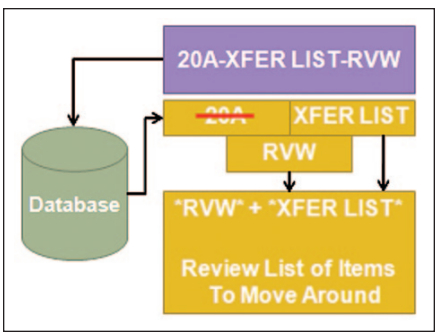

Fig. 3. Assembled Translation: *The name 20A-XFER LIST-RVW is decomposed using dashes as delimiters. Each fragment is translated separately, and a sentence is assembled from the translated fragments.*

based on a qualitative assessment of the overall suitability of the resulting translations. Figure 1 is an example of direct translation. In this technique, the database contains a rule that encompasses the whole input string, NOD2-PRE-ACT-C/O, so the translation is considered complete by the application of this single rule. In figure 2, the input string 1553-EXT-DUMP was not found in the database, so it is split into fragments using the dashes as delimiters. These fragments are then recombined into all possible combinations that maintain word order. As shown in figure 2, there are three such combinations for the input 1553-EXT-DUMP and one of the combinations, EXT-DUMP, is a rule so the translation is completed. In the final technique—assembled translation—the input is again decomposed using dashes as delimiters, but the fragments are translated individually and any that do not have a rule are ignored. Figure 3 uses the example input 20A-XFER LIST-RVW. 20A does not have a rule, but XFER LIST and RVW do have rules and can be translated individually. In an assembled translation, the rules are categorized and the final output is created by applying a scheme that places the individual translations in an order designed to enhance the readability of the translation. The order is: CONFERENCE – PERSON – VERB – OWNER – SYSTEM – EXPERIMENT – HARDWARE – GENERIC. Qualitative testing indicated this order often results in a sentence that meets a reasonable level of understanding. If an activity cannot be translated by one of the three techniques, it is left "as is."

Data Protection

In addition to translation, the rules also serve a secondary but essential function for ISS*Live!*—the protection of sensitive data. There are a variety of reasons why data may be sensitive. Protection of those data is accomplished by a database flag for each rule. By default, all translations are considered sensitive and can only be considered public if the translation was built using a rule that is specifically designated as public. For direct and partial translations, this concept is straightforward; the translation is public if the rule used is designated as such. Assembled translations are public if any of the individual fragments use a rule that is tagged as public. This also means that any unsuccessful translations will be automatically sensitive, since no rule was successfully applied to designate them as public.

Outputs

The ISS*Live!* translator does not pass all operational data to the front-end applications. Only data that suits the purpose of the ISS*Live!* timeline display and application programmer interface are forwarded, and some of those data are modified during the translation process. In this way, the translator acts as a filter that reduces the bulk of operational data to its bare essentials, and reformats that information in a manner acceptable to the front-end applications.

Future Work

The ISS*Live!* translator has successfully demonstrated a method to convert operational activities into descriptions designed for the public. The application is an essential component of the ISS*Live!* software suite and will support the release of ISS operational data to a public that currently enjoys only limited access to such data. The rules database is currently under construction by a dedicated group of experts at Johnson Space Center, and a sustaining plan to accommodate the evolving nature of ISS operation is in works. ISS*Live!* has been deployed to the NASA portal (www.nasa.gov).